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(54) **Completing telecommunications calls in a competitive environment**

(57) In an environment of competitive local and interexchange carriers, offering number portability between local carriers serving a common region and between switches serving that region, each local carrier accesses a regional database to determine the identity of the carrier and switch serving a local customer. In addition, interexchange carriers access a national database to determine the identity of the carrier and switch serving the customer specified by the number dialed by

an originating customer. For customers requiring high reliability service, alternate carriers can be used to serve such customers in case the primary carrier is unavailable; the databases identify these alternate carriers. Advantageously, this arrangement allows a high degree of freedom of movement of customers between carriers and geographic relocation without requiring a number change.

**Description****Technical Field**

This invention relates to methods and apparatus for providing competitive, local and toll service in a national telecommunications network.

**Problem**

The U.S. telecommunications network is in a state of transition. During the next several years, it is expected that the monopoly held by local exchange carriers will be substantially altered and that Competitive Access Providers (CAPs) will begin to offer customer access for toll calls to the already competitive interexchange carriers, will provide local exchange service, or both. In order to accomplish this goal without creating an excessive burden on customers who wish to receive service from a CAP, it is expected that there will be a requirement that a change to a CAP need not be accompanied by a change of telephone number. Further in the long run, it is expected that customers will be able to move to another geographic location within some reasonably defined region, and, in moving, change their local carrier, the switch from which they are being served, or both. The ability to change service providers without moving is called service provider number portability; the ability to change location without changing a service provider is called geographic number or location portability. It is expected that in the not too distant future both will be required. In order to provide service in the face of service provider number portability and geographic number portability, the traditional tie between a customer's serving central office and the NPA-XXX portion of that customer's telephone number will have to be broken and alternate arrangements provided. Such alternate arrangements already exist for 700 service wherein the last seven digits of a 700 number bear no relation to the geographic location of the associated telephone customer. Other service access codes such as 500 are being planned for use with similar services. At the present time, this type of facility is limited to a small fraction of telephone customers. Accordingly, the problem in the prior art is that no sound economic arrangement has been proposed which offers geographic number portability and service provider number portability to most telephone customers.

**Solution**

The above problem is solved and an advance is made over the prior art in accordance with our invention wherein each local exchange carrier is provided with access to a local universal database listing all numbers for a given local region served by a local exchange carrier and wherein each interexchange carrier is provided with access to a national database listing all numbers for the

nation. (Clearly, both of these databases can be implemented incrementally during a period of transition wherein for example, the national database need only store data for regions which have implemented service provider number portability and/or geographic number portability and within these regions only for office codes which have diversity in the location and/or the local exchange carrier of their subscribers.) For local calls, the local database is accessed to determine the identity of the terminating local exchange carrier and the terminating switch of the called customer while the national database is accessed to obtain similar information for toll calls. Advantageously, with this arrangement, the originating switch or a switch of an interexchange carrier can determine the identity of the local carrier serving the called customer and the switch from which that called customer is served.

In accordance with one feature of the invention, an alternate terminating carrier and terminating switch can be identified for customers who require especially reliable service so that if the preferred carrier and switch are inaccessible, the terminating customer may be reached by an alternate route. In accordance with another aspect of the invention, call detail records for individual calls include the identity of the terminating exchange carrier and switch for toll calls. The originating local carrier and switch must also be identified if the interexchange carrier is to produce the billing record for a call, in order to rate calls properly with geographic and/or service provider portability.

For local carrier switches for local or toll calls, the identity of the originating local exchange carrier and switch, or the interexchange carrier, respectively, can be optionally recorded in order to allow a single billing center to process calls from a plurality of carriers without requiring that the records of each carrier and switch be segregated.

**Drawing Description**

FIG. 1 is an overall block diagram illustrating the operation of applicant's invention;

FIG. 2 is a block diagram illustrating the arrangement for updating national and local databases;

FIGS. 3-6 are flow diagrams illustrating the operation of applicant's invention; and

FIGS. 7 and 8 are diagrams illustrating the establishment of toll and local calls in accordance with applicant's invention.

**Detailed Description**

FIG. 1 is a block diagram showing the relationship between telephone customers, local service providers (i.e., local exchange carriers) and interexchange carri-

ers. Individual customers 1-5 serve to originate or terminate telephone traffic. Some of these customers, such as customers 1 and 4, are connected to two carriers in order to provide especially reliable service. Local exchange carriers 6-10 are connected to the customers and are connected to interexchange carriers 11-13. Each local exchange carrier includes one or more switches 17, a local universal database (LUDB) 18 and a billing recording system 19. Alternatively, a local universal database can be shared by several or all local carriers. The switches are for establishing telephone connections in the conventional way and are interconnected by the links shown in FIG. 1. The database 18 need only contain data for the telephone numbers of the region served by the local exchange carrier. Each of the local exchange carriers serving a particular region stores in its database data concerning all the numbers of the region so that in a broad sense, each of the databases contain the same data. The database for a particular region and a particular carrier is accessed through data links from each of the switches of the carrier serving that region. While FIG. 1 shows individual databases for each local exchange carrier, these databases could be shared among a plurality of such local exchange carriers; this is particularly straightforward since the databases are accessed using data links.

The local exchange carriers are connected to interexchange carriers 11, 12, ..., 13, each of which contains one or more switches 14, and access to a national universal database (NUDB) 15 and a billing record system 16. The remarks made previously about the local database are also applied to the national database which, of course, is very much larger. This national database can be concentrated or distributed and can be shared among a plurality of interexchange carriers since it is accessed by data links from the switches that use the data of the database.

FIG. 2 shows an arrangement for updating the local and national databases. A centralized service management system 201 transmits update messages to individual carrier local number portability service management systems 202 which transmit update messages to the local databases 203 of each of the carriers 204. Similarly, the centralized service management system 201 transmits data messages to interexchange carrier local number portability service management systems 210, each of which are used to update the national databases 211 of each of the carriers 212.

Local access providers must provide update information to the centralized service management system 201. The customer's new local service provider is responsible for the update for the case in which the customer changes service providers. When a customer switches carriers, the original local carrier may be required to forward calls for a short period (a few days) until the database has been updated.

FIG. 3 is a flowchart of the routing procedure for this kind of arrangement. The local exchange carrier switch

receives the call (action block 301). The local carrier switch makes a translation whether this is a local or a toll call (test 303). If geographic number (location) portability has been implemented in the region where the call is received, then in order to successfully complete test 303, the local database will return the preferred terminating local exchange carrier and the switch from which the terminating customer is served and this can be used in conjunction with the identification of the originating switch to determine whether this is a local or toll call. A call will also be a toll call if it is recognized that the local database will not contain data for that terminating customer. This can be determined, for example, from the NPA code of the terminating customer, or if geographic number (location) portability has not been implemented from the office code of the called number. If as a result of test 303 it is determined that this is a toll call, then the call is routed to the pre-subscribed interexchange carrier or if the customer specifies an interexchange carrier by dialing an appropriate code, then to the specified dialed interexchange carrier (see action block 305). The interexchange carrier receives the Automatic Number Identification (ANI) of the calling customer, and the Dialed Number (action block 307). The interexchange carrier then accesses the national database to determine the terminating carrier (and alternate where provided) and the terminating switch (and alternate where specified) (action block 309). The interexchange carrier then routes the call to an egress switch serving the preferred terminating carrier and transmits the terminating carrier and local office identification (action block 311). Test 313 determines whether the preferred carrier is available; if so, the call is completed to the called customer via that terminating carrier (action block 315). If the preferred carrier is not available (negative result of test 313), then test 317 determines whether an alternate carrier has been specified. If so, then test 319 determines whether the alternate carrier is available. If so, the call is routed to the alternate carrier for completion to the called customer (action block 321). If the alternate carrier is unavailable, then the call is blocked and given blocked call treatment (action block 323). Similarly, if no alternate carrier had been specified (negative result of test 317) then the call is also blocked (action block 323).

If the result of test 303 for determining whether this is a local or toll call is that the call is a local call, then action block 401 (FIG. 4) is entered. In action block 401 the local exchange carrier switch queries the local database to determine the preferred carrier and switch (and alternate carrier and switch if so specified). Test 403 is used to determine whether the preferred carrier is available. If so, then the call is routed to the preferred carrier, and the terminating carrier and end office identification are transmitted toward the terminating carrier (action block 405). If not, test 407 determines whether an alternate carrier has been specified. If so, test 409 determines whether the alternate carrier is available. If

so, then the call is routed to the alternate carrier for completion to the called customer. If the alternate carrier is not available (negative result of test 409) or if no alternate carrier had been specified (negative result of test 407) then the call is given blocked call treatment (action block 413).

FIG. 5 is a flow diagram showing the actions performed for billing a toll call. The interexchange carrier receives the ANI and Dialed Number (action block 501). The interexchange carrier translates the incoming trunk identification to identify the originating carrier (action block 503). Alternatively, signaling information from the originating carrier can identify that carrier. The interexchange carrier then queries the national database to identify the terminating carrier and switch for the called number (action block 505) and the interexchange carrier prepares a call detail record including the ANI, Dialed Number, originating and terminating local carrier identification and switch identification, the interexchange carrier identity (in case billing records are processed for several carriers by a single processor), and elapsed time for the call (action block 507).

FIG. 6 is the billing procedure for local calls. The local carrier receives the Dialed Number and the ANI of the originating customer (action block 601). The local carrier then queries the local database to identify the terminating carrier and switch based on the Dialed Number (action block 603). The local carrier then prepares a call detail record including the ANI, Dialed Number, the terminating carrier and terminating switch identification.

For the case that the alternate terminating carrier is used, the alternate terminating carrier and switch are substituted for the preferred carrier and switch in the call detail record.

FIG. 7 illustrates a toll call and illustrates some of the ways in which the arrangement described herein has flexibility. A customer 701 has access to three different local carriers: namely, Local Exchange Carrier 711, Competitive Access Provider 713 and Cable TV provider 715. Assume that this customer elects for a particular call to use the Competitive Access Provider 713. When the toll call arrives at the ingress switch 731 of the selected interexchange carrier, the call is routed to the egress switch of interexchange carrier 733, either the ingress switch or the egress switch may query a national universal database 741 to obtain information as to the carrier and office serving the called customer. The interexchange carrier switch querying database 741 supplies the called party number (NPA-NXX-XXXX) and receives in response the identity or identities of the carrier(s) and end office(s) of the local carrier serving the called customer. It is also possible that the database is queried from an intermediate switch of the selected interexchange carrier; this might happen, for example, if the call is of a special type handled by a specialist interexchange carrier switch. At any rate, the egress switch is informed, either by the querying switch, or di-

rectly by the database if the egress switch is the querying switch, of the identity of the preferred carrier(s) and the identity of the end office for each such carrier. The call is then routed, in this case via CATV carrier 725, to the terminating customer. Note that in the terminating region there is also a Local Exchange Carrier 721 and the Competitive Access Provider 723, so that there is an alternative for completing the call to the called customer 703. In order to provide revenue to the carrier that actually processed the call, the identity of the originating and terminating local carrier, as well as the interexchange carrier, are provided either explicitly to the call detail records or implicitly because the record is made by a particular carrier.

FIG. 8 illustrates a local call and illustrates some of the ways in which the arrangement described herein has flexibility. A customer 801 has access to three different local carriers, namely local exchange carrier 811, Competitive Access Provider 813 and Cable TV provider 815. Assume that this customer elects for a particular call to use the Competitive Access Provider 813. When the local call arrives at a switch at Competitive Access Provider 813, the switch from the Competitive Access Provider 813 accesses local universal database 841 with the dialed number (NPA-NXX-XXXX) and receives in response the identity or identities of the carrier(s) and end office(s) of the local carrier serving the called customer. The Competitive Access Provider then routes the call via the preferred carrier which may be local exchange carrier 811 or Cable TV provider 815. Note that in the particular case where illustrated in the diagram wherein called customer 803 has access to all three carriers, the call can be routed via a non-preferred carrier if access via the preferred terminating carrier is blocked.

In order to provide revenue to the carrier that actually processed the call, the identity of the originating and terminating local carrier are provided either explicitly to the call detail record or implicitly because the record is made by a particular carrier.

While in the preferred embodiment, the interexchange carrier accesses the national database, the originating carrier can alternatively be arranged to access that database and forward the identity of the terminating carrier(s) and switch(es) to the interexchange carrier.

For a local operator assistance call, the local carrier determines that the call is a local operator call and sends the call to a local operator assistance system which may be part of the calling party's local carrier network, or in another local network (operator systems can serve multiple local networks). The originating local carrier is identified to the operator system either by incoming trunk information or signaling. The operator system performs the requested operator service and then queries the LUDB to get the terminating carrier and terminating switch. It routes the call to the terminating carrier, passing the carrier and switch identification. The operator system makes a call detail record that includes both the originating and terminating, carrier and switch, identifi-

cations.

For a toll operator call, the local carrier determines that the call is a toll operator call and sends the call to the subscribed or dialed toll carrier operator system. The originating local carrier is identified to the toll operator assistance system either by incoming trunk information or signaling. The operator system performs the requested operator service and routes the call to a toll ingress switch. >From here, routing is the same as a toll call - the ingress toll switch queries the NUDB, etc. When the toll call is successfully routed, the terminating carrier and switch identifications are signaled in the backwards direction to the operator system to be included in the call detail record.

It is to be understood that the above description is only of one preferred embodiment of the invention. Numerous other arrangements may be devised by one skilled in the art without departing from the scope of the invention. The invention is thus limited only as defined in the accompanying claims.

## Claims

1. In a telecommunication network, a method of establishing a telecommunications call, comprising the steps of:

receiving a Dialed Number dialed by a caller at a first switch of a first local carrier;  
determining whether said Dialed Number is for a local exchange area call;  
if it is determined that said Dialed Number is for a local exchange area call, accessing a local database to determine a preferred terminating carrier, prespecified by a called party identified by said Dialed Number, and switch prespecified by said preferred terminating carrier for serving said call; and  
routing said call to said preferred terminating carrier for completing said call.

2. The method of claim 1 wherein the step of accessing the local database comprises the step of

accessing said local database to determine a preferred terminating and an alternate terminating carrier local exchange area and preferred and alternate switch prespecified by said preferred terminating and said alternate terminating carrier, respectively, for serving said call; and  
wherein the step of routing said call further comprises the step of routing said call to said alternate carrier if said preferred carrier is not available.

3. The method of claim 1 or claim 2 further comprising

the step of: preparing a call detail record for said call, said billing record comprising an identity of a terminating carrier selected for routing said call.

5 4. The method of claim 1 further comprising the step of: determining whether this is a local exchange area toll call;

10 responsive to a determination that this is a local exchange area toll call, determining whether the caller has subscribed to or specified an interexchange carrier for local exchange area toll calls; and

15 responsive to a determination that the caller has subscribed to or specified an interexchange carrier for local exchange area toll calls, routing said call to the subscribed to or specified interexchange carrier for a determination of the terminating carrier and switch serving the called party specified by the Dialed Number.

20 5. The method of claim 1 further comprising the step of: determining whether this is an interexchange call responsive to determining that said Dialed Number is for an interexchange call, querying a national database to determine a terminating carrier and switch for serving said Dialed Number.

25 6. The method of claim 5 wherein said national database is accessed by an interexchange carrier.

30 7. The method of claim 5 wherein said national database is accessed by said first local carrier.

35 8. In a telecommunication network, a method of establishing a telecommunications call, comprising the steps of:

40 receiving a Dialed Number dialed by a caller at a first switch of a first local carrier;  
determining whether said Dialed Number is for an interexchange call;  
if it is determined that said Dialed Number is for an interexchange call, routing said call to an interexchange carrier;  
accessing a national database from said interexchange carrier to determine a preferred terminating local carrier prespecified by a called party identified by said Dialed Number, and switch prespecified by said preferred terminating carrier for serving said call; and  
routing said call to said preferred terminating local carrier and switch.

45 9. The method of claim 5 or 8 wherein the step of:

50 accessing said national database comprises

the step of querying said national database to determine an alternate terminating carrier prespecified by a called party identified by said Dialed Number, and switch prespecified by said alternate terminating carrier for serving said call. 5

10. The method of claim 5 or 8 further comprising the step of:

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preparing a call detail record comprising an identification of said first local carrier and an identification of at least one carrier selected to route said call to the customer identified by the Dialed Number. 15

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FIG. 1

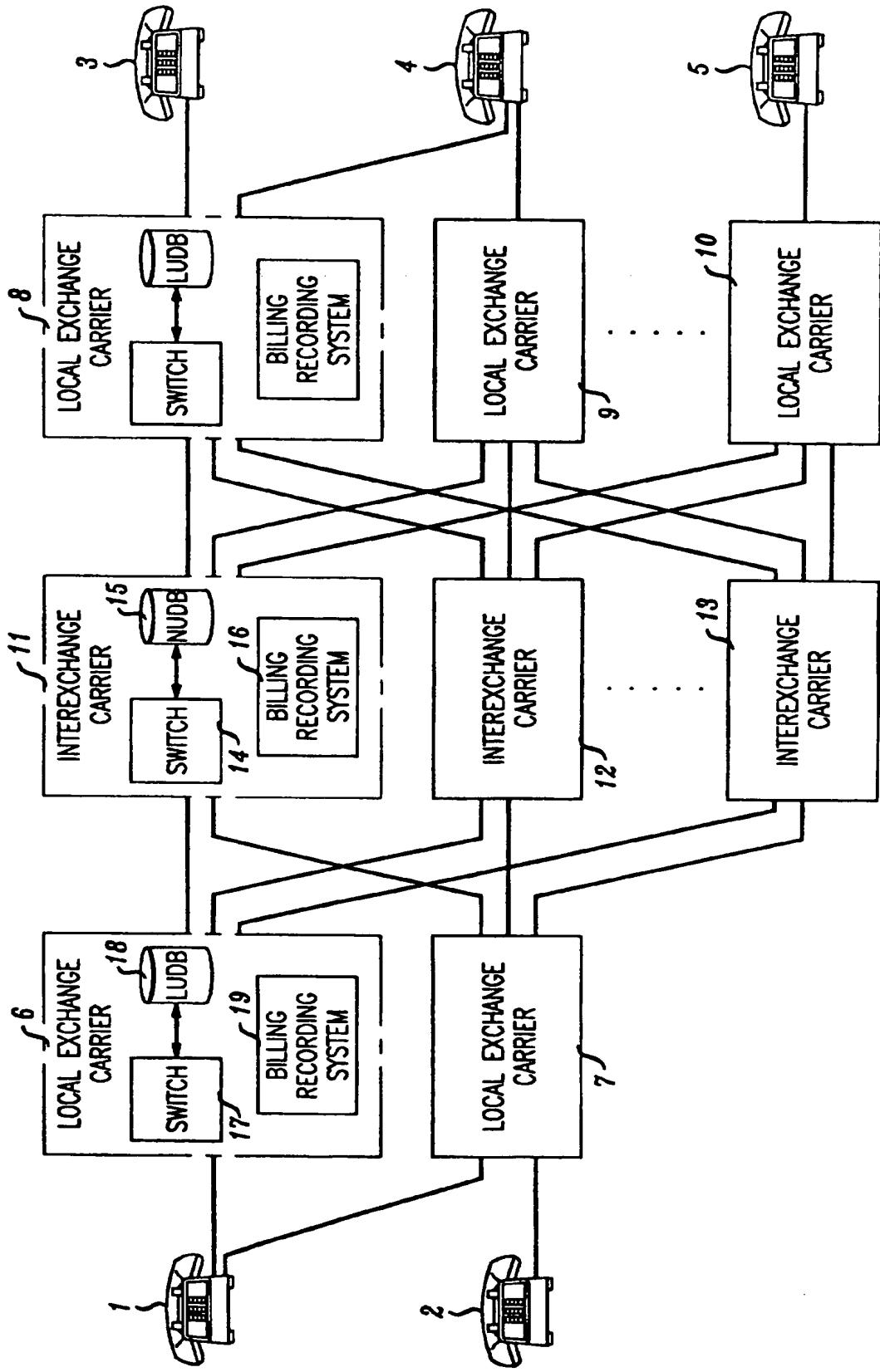


FIG. 2

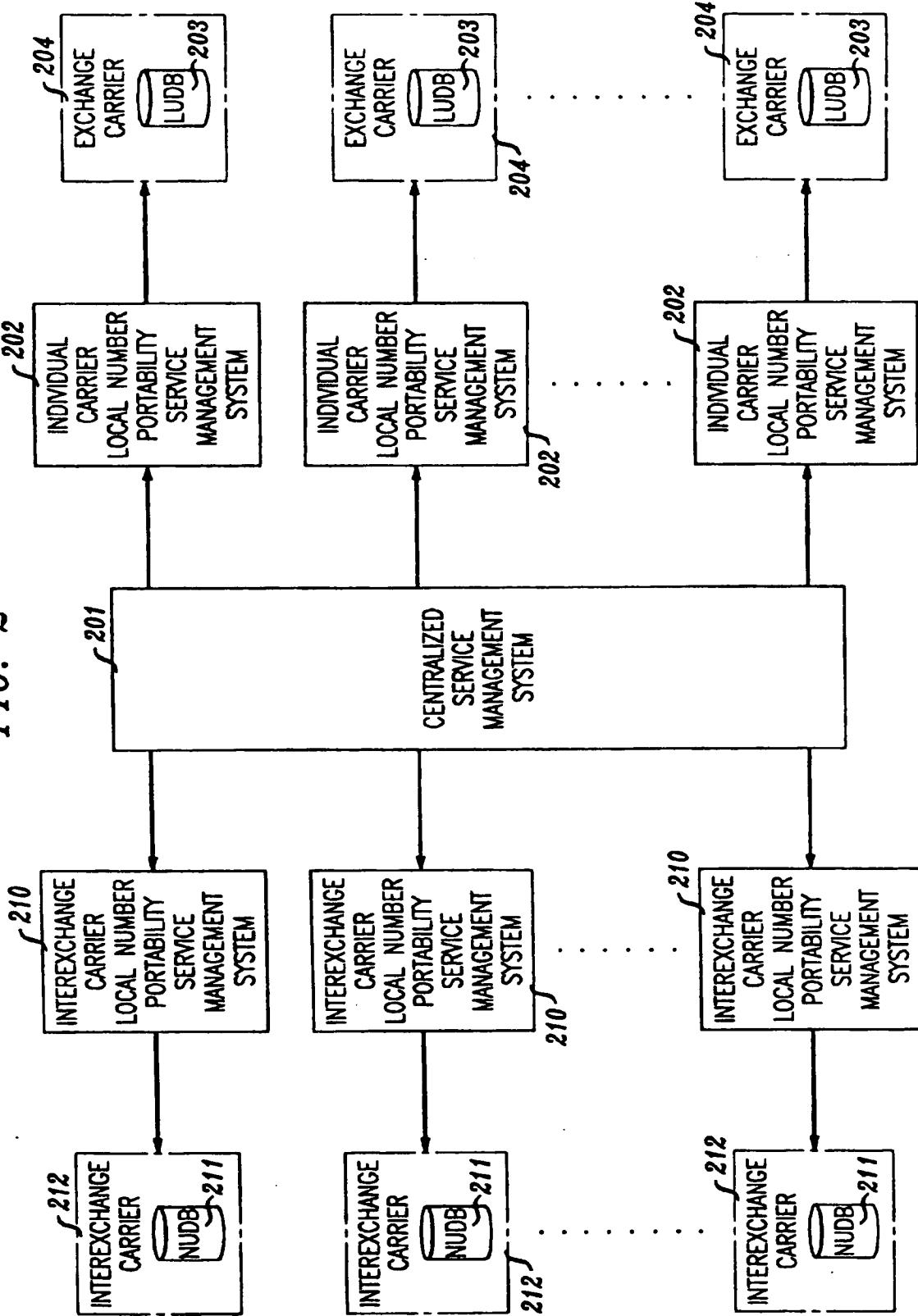


FIG. 3

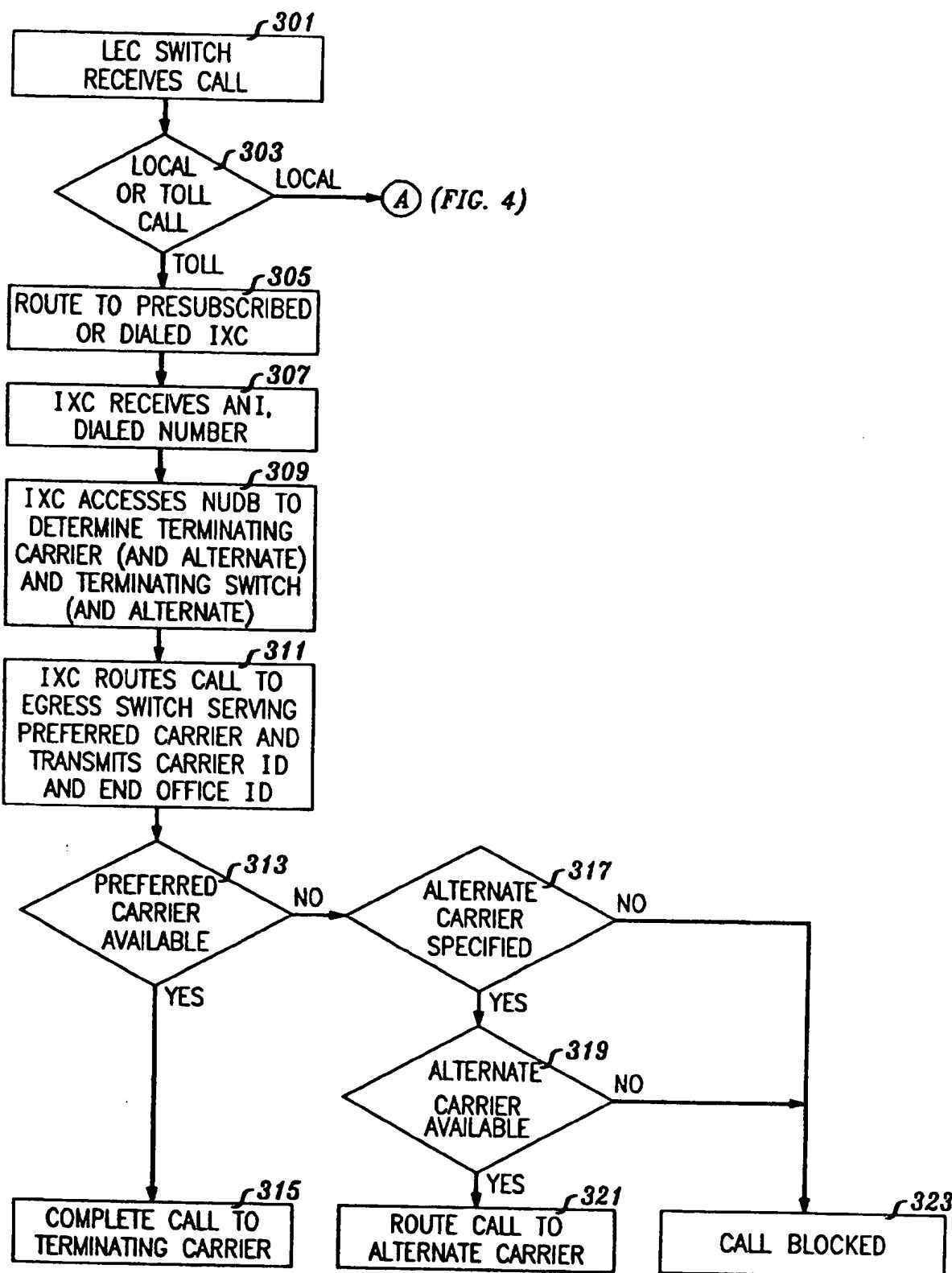


FIG. 4

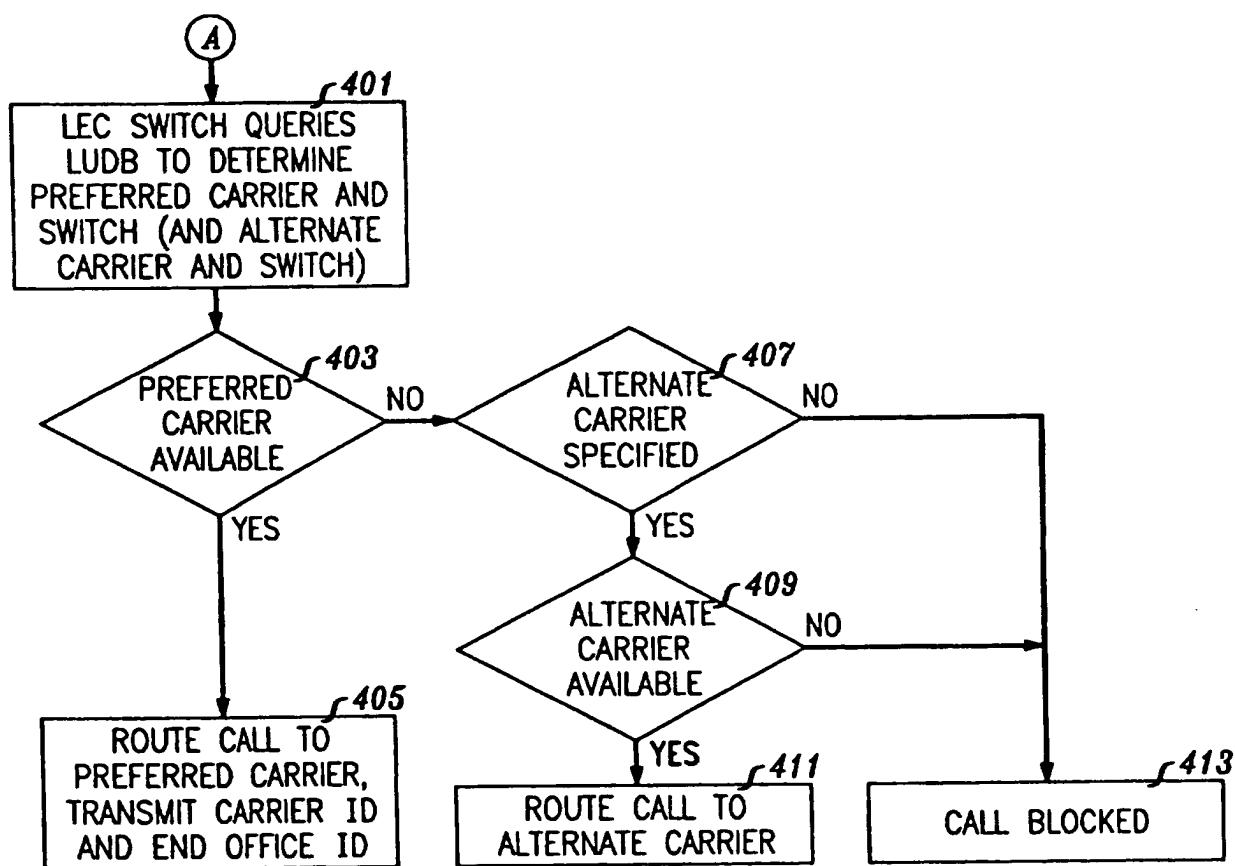


FIG. 5

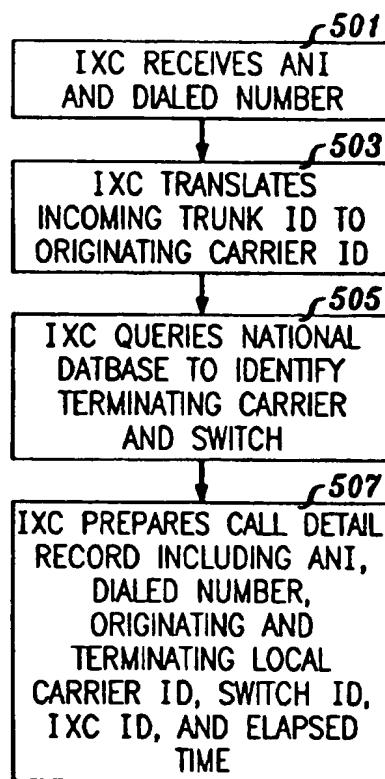


FIG. 6

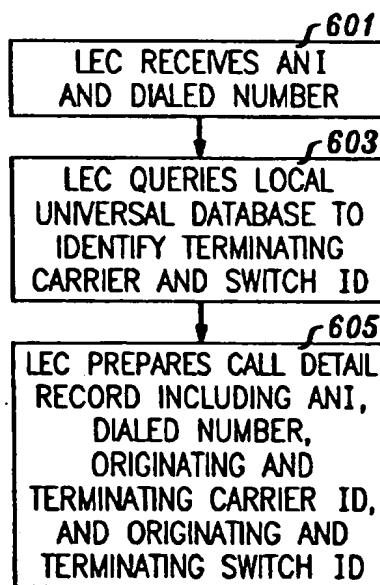


FIG. 7

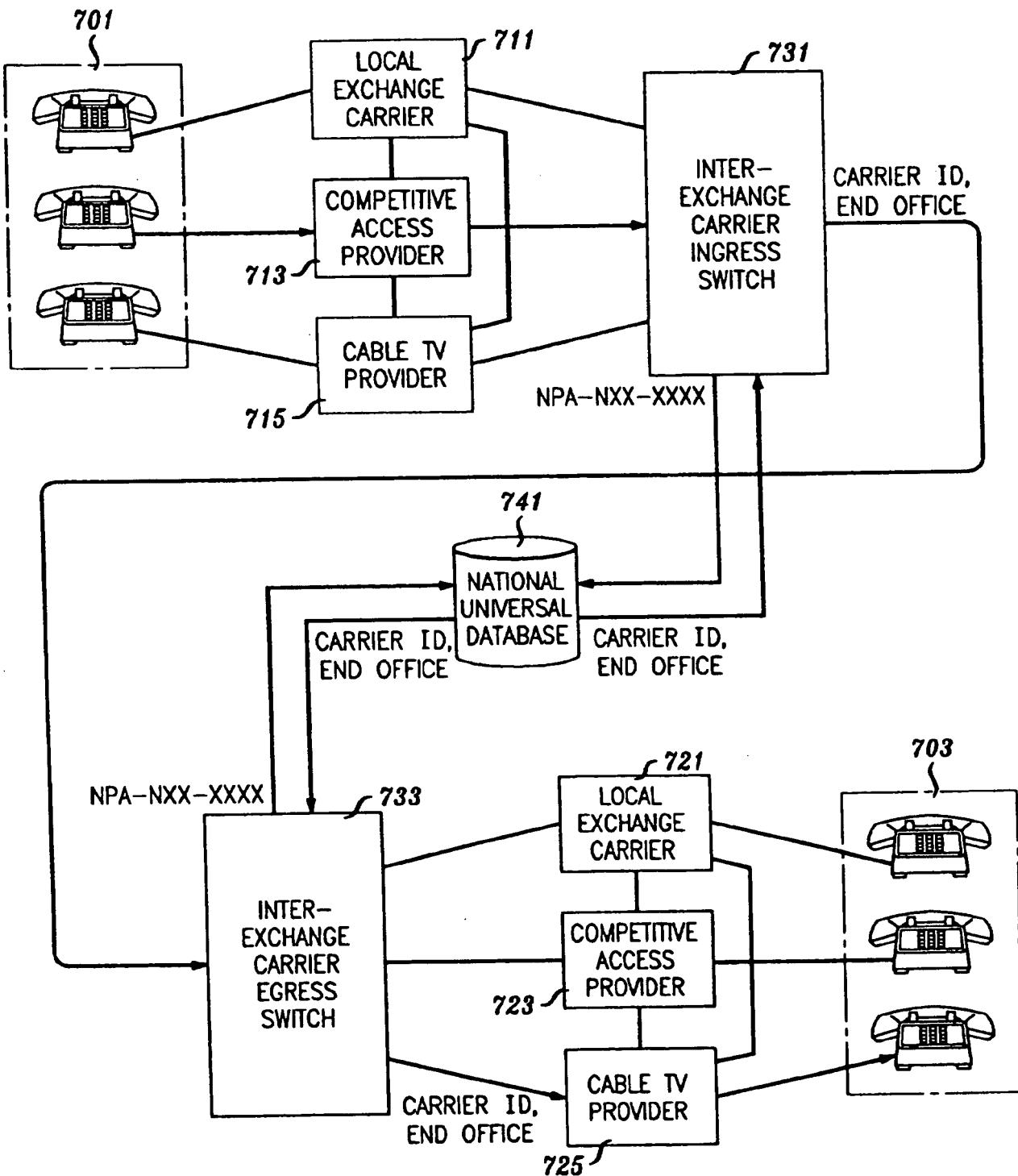
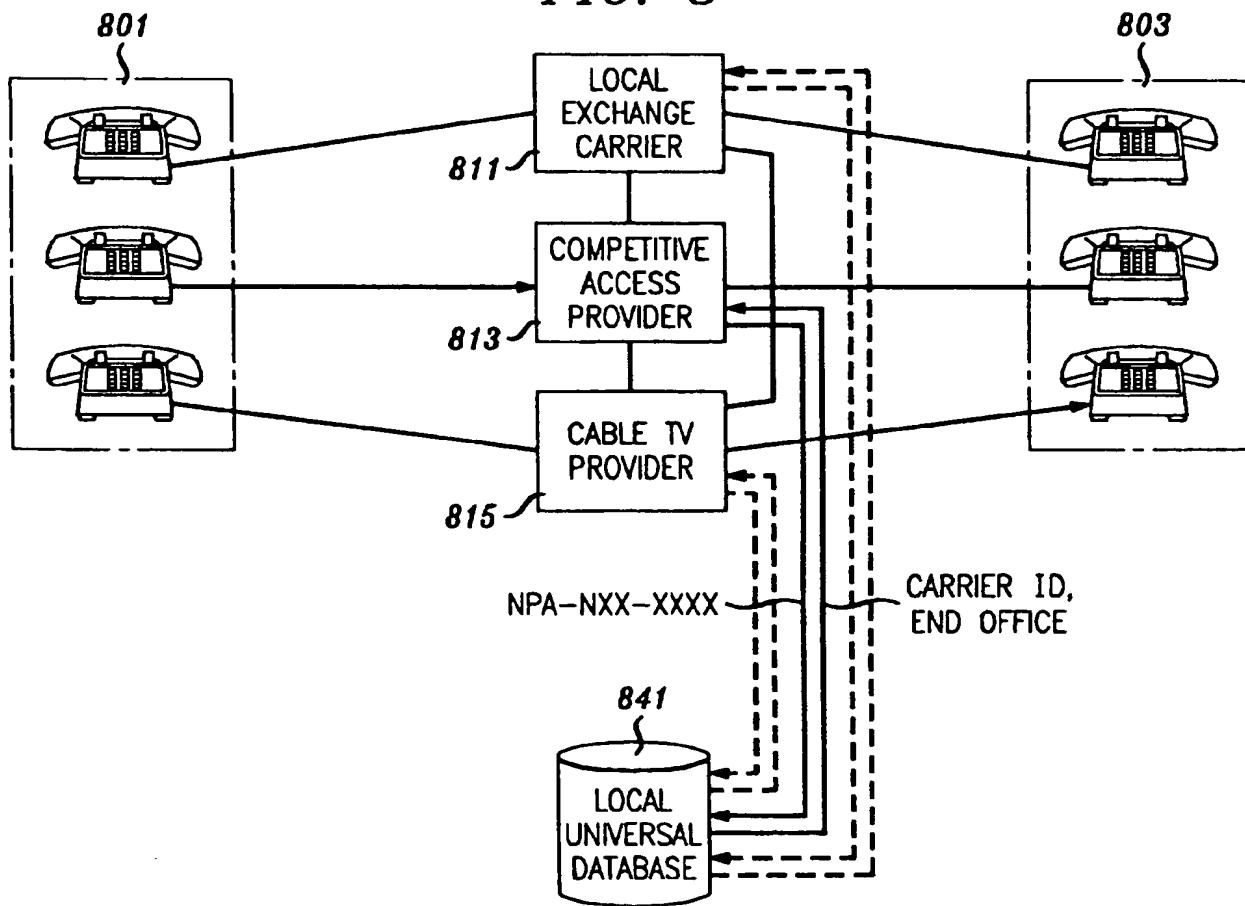
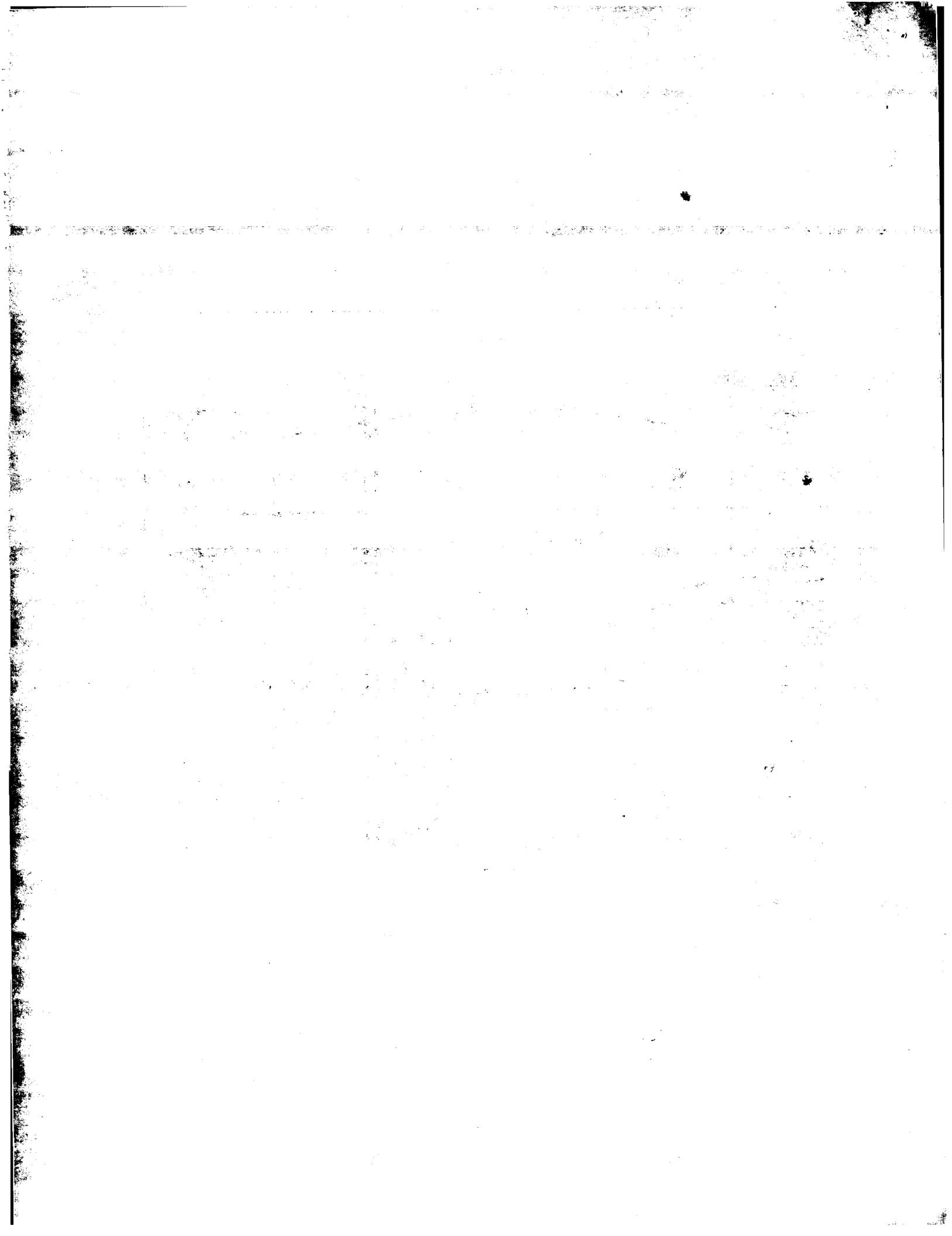


FIG. 8







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serving the customer specified by the number dialed by an originating customer. For customers requiring high reliability service, alternate carriers can be used to serve such customers in case the primary carrier is unavailable; the databases identify these alternate carriers. Advantageously, this arrangement allows a high degree of freedom of movement of customers between carriers and geographic relocation without requiring a number change.



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Office

## EUROPEAN SEARCH REPORT

Application Number  
EP 95 30 7183

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	EP-A-0 608 066 (AT&T CORP) * column 5, line 53 - column 6, line 38 * * column 10, line 27 - line 50 * ---	1-10	H04Q3/00 H04M3/42
A	US-A-4 791 665 (BOGART ET AL.) * column 5, line 31 - column 8, line 18; figures 3,4 *	1-10	
A	INTERNATIONAL CONFERENCE ON COMMUNICATIONS, vol. 2, 23 June 1985, CHICAGO US, pages 791-794, XP002009743 AVERWEG ET AL.: "The impact of divestiture on 5ESS switch software" * page 792, left-hand column, paragraph 2 - page 793, left-hand column, last paragraph *	1,2,4-10	
A	US-A-4 797 915 (BOWKER ET AL.) * column 7, line 54 - column 8, line 53 *	1,2,4-10	
A	US-A-4 577 066 (BIMONTE ET AL.) * column 3, line 61 - column 6, line 2 *	1,2,4-10	H04Q
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
Place of search	Date of completion of the search	Examiner	
THE HAGUE	31 July 1996	Lambley, S	
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons -----           & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			